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Review of Published Export Coefficient and Event Mean Concentration (EMC) Data

by Jeff P. Lin

PURPOSE: This technical note summarizes and reviews published export coefficient and event mean concentration (EMC) data for use in estimating pollutant loading into watersheds. These numbers can be used to measure pollutant loadings into wetlands having their own defined catchment. This can be useful for regulatory and planning purposes, such as estimating the impact of changing land use on wetlands, or analyzing the effects of wetlands on mitigating pollutant loads into water bodies. This note also discusses possible regional trends in export coefficients and EMCs, and the utility of "regionalized" values.

BACKGROUND: Several water quality models used to estimate non-point water pollution into watersheds require the input of either export coefficients (typically for rural areas) or event mean concentrations (typically for urban areas). EMCs represent the concentration of a specific pollutant contained in stormwater runoff coming from a particular land use type within a watershed. Export coefficients represent the average total amount of pollutant loaded annually into a system from a defined area, and are reported as mass of pollutant per unit area per year (e.g. kg/ha/yr). EMCs are reported as a mass of pollutant per unit volume of water (usually mg/L).These numbers are generally calculated from local storm water monitoring data.

Since collecting the data necessary for calculating site-specific EMCs or export coefficients can be cost-prohibitive, researchers or regulators will often use values that are already available in the literature. If site-specific numbers are not available, regional or national averages can be used, although the accuracy of using these numbers is questionable. Due to the specific climatological and physiographic characterisitics of individual watersheds, agricultural and urban land uses can exhibit a wide range of variability in nutrient export (Beaulac and Reckhow 1982).

This technical note reviews and presents a selection of local, regional, and national EMCs and export coefficients published in journal articles and government reports, as well as previous literature reviews done on the subject. This is not meant to be a complete or comprehensive compilation of all available EMCs and export coefficients as it does not include unpublished data, or data from sources with limited disbursement. Since the literature reviewed here does not cover all areas of the United States, researchers or regulators should use their own professional judgment as to the applicability of any published values to their region or area of interest.

LITERATURE REVIEW

- **Export Coefficients.** Export coefficients are generally used for calculating runoff pollutant loads for rural land use types. The most common pollutants for which export coefficients are usually generated are total nitrogen (TN) and total phosphorus (TP). The following major older papers/reports compiled and reviewed some of the coefficients published at the time:

- **Reckhow et al. (1980): "Modeling Phosphorus Loading and Lake Response under Uncertainty: A Manual and Compilation of Export Coefficients."** This report presents tables of export coefficients for TP and TN obtained through a comprehensive literature survey. TN export coefficients are provided for most of the references, and TP export coefficients are provided for all of the references listed in the tables. The report is available on the EPA National Environmental Publications website, through this link:

  http://www.epa.gov/cgi-bin/claritgw?op-Display&document=clserv:OAR:0563;&rank=4&template=epa

  This report is also summarized in a later paper by the authors (Beaulac and Reckhow 1982).

  The export coefficients included in this report were all screened using certain acceptance criteria, based on the accuracy, precision, representativeness, and temporal extent of data sampling. Export coefficients obtained from unbiased and established sampling methods and coefficients estimated using continuous flow data were reported. The authors also provide advice as to the criteria that should be considered when selecting coefficients for use in a particular water quality model.

  Export coefficients reported in this paper cover the following general land use types in certain areas of the indicated states/provinces:

  - **Forested:** Ontario, Minnesota, New Hampshire, Ohio, Tennessee, West Virginia, Georgia, Maryland, Texas, Mississippi, Washington, Oregon.
  - **Row Crops**: Wisconsin, Minnesota, Iowa, Georgia, Alabama, Mississippi, Oklahoma, Maryland.
  - **Non-Row Crops:** Saskatchewan, Wisconsin, South Dakota, Oklahoma, Alabama, Minnesota.
  - **Pasture/Grazed:** North Carolina, South Dakota, Ohio, Iowa, Georgia, Maryland, Oklahoma.
  - **Animal Feedlots/Manure Storage**: Ontario, South Dakota, Nebraska, Vermont.
  - **Mixed Agriculture:** Ontario, Indiana, Ohio, Iowa, Florida, Washington, DC.
  - **Urban**: Ontario, Wisconsin, Michigan, Ohio, Tennessee, North Carolina, Virginia, Florida.

  Export coefficients are usually from specific cities or watersheds within the state, and are broken down into more specific land use types (corn row crops, for example). Data on soil type and annual precipitation are provided for most of the references.

  The report provides mean TN and TP export coefficients for each of the land use types, which are summarized here.

Table 1
Mean, Range, and Sample Size of all TP and TN Export Coefficients[1]

Land Use	TP and TN Export Coefficients (kg/ha/yr)					
	Mean		Range		Sample Size	
	TP	TN	TP	TN	TP	TN
Forested	.236	2.86	.019 - .830	1.38 - 6.26	26	11
Row Crops	4.46	16.09	.26 - 18.6	2.1 - 79.6	26	26
Non Row Crops	1.08	5.19	.10 - 2.90	.97 - 7.82	13	10
Pasture	1.50	8.65	.14 - 4.90	1.48 - 30.85	14	13
Feedlot/Manure Storage	300.7	3110.7	21.28 – 795.20	680.5 - 7,979.9	13	7
Mixed Agriculture	1.134	16.53	.08 - 3.25	2.82 - 41.50	20	21
Urban	1.91	9.97	.19 - 6.23	1.48 - 38.47	23	19

[1] Adapted from Reckhow et al. (1980).

- **Rast, W., and Lee, G. F. (1978): Summary Analysis of the North American (US Portion) OECD Eutrophication Project: Nutrient Loading – Lake Response Relationships and Trophic State Indices.** This report provides more "national" or generalized export coefficient values of nitrogen and phosphorus (Table 2) for three major land uses (urban, rural/agriculture, and forest). These export coefficients are also presented in a shorter paper by Rast and Lee (1983). The authors derived their national numbers based on previous compilations of export coefficients by Sonzogni and Lee (1974), Uttomark et al. (1974), and the U.S. Environmental Protection Agency (USEPA) (1974).

Table 2
General TP and TN Export Coefficients

Land Use	Nutrient Export Coefficients (kg/ha/yr)		
	TP	TN, Eastern U.S.	TN, Western U.S.
Urban	1.0	5.0	2.5
Rural/Agriculture	0.5	5.0	2.0
Forest	0.05-0.1	3.0	1.0

[1] Adapted from Rast and Lee (1978).

Although the report also contains TP and TN export coefficients for 32 lake watersheds throughout the United States, these coefficients are not broken down by land use.

- **Loehr, R. C., Ryding, S. O., and Sonzogni, W. C. (1989). Estimating the Nutrient Load to a Waterbody. "*The Control of Eutrophication of Lakes and Reservoirs, Volume I, Chapter 7.*"** This chapter includes ranges of TP and TN export coefficients from various land use types (Table 3). These numbers are updated from an earlier paper by Loehr (1974), which is a compilation of export coefficients for a variety of constituents, measured at various locations in the United States and Europe.

Table 3
Ranges of Measured TP and TN Export Coefficients for Various Land Uses[1]

	Range of TP and TN Coefficients (kg/ha/yr)	
Land Use	**TN**	**TP**
Rural cropland	2.1 - 79.6	0.06 - 2.9
Idle land	0.5 - 6.0	0.05 - 0.25
Forest	1.0 - 6.3	0.007 - 0.88
Pasture	3.2 - 14	0.05 - 0.6
Manure storage	4 - 13	0.8 - 2.9
Feedlots	100 - 1600	10 - 620
Residential	5 - 7.3	0.77 - 2.2
Commercial	1.9 - 11	0.1 - 7.6
Industrial	1.9 - 14	0.4 -4.1

[1] Adapted from Loehr et al. (1989).

- **Frink, C. R. (1991). Estimating Nutrient Exports to Estuaries.** This publication is a more recent literature review of TN and TP export coefficients, although it also includes values from several of the older references listed above. Ranges and median/mean export coefficients for a variety of land use types as reported by each individual reference are listed in tabular form. However, except for Connecticut lakes, Chesapeake Bay, and Long Island Sound, the geographic areas from which these coefficients were obtained is not readily obvious through the paper. Because the table is fairly large, it is not reproduced here.

Many published articles/reports classify export coefficients by land use, measured for a specific area or watershed(s) in the United States. Examples include:

- **McFarland, A. M. S, and Hauck, L. M. (2001). Determining Nutrient Export Coefficients and Source Loading Uncertainty Using In-Stream Monitoring Data.** This publication contains TP and TN export coefficients developed from monitoring 13 sites in the upper North Bosque River watershed, located in central Texas. Coefficients were developed for four major land uses within the watershed (Table 4).

Table 4
TP and TN Export Coefficients by Land Use for the Upper North Bosque River Watershed, TX[1]

	TP and TN Coefficients (kg/ha/yr)	
Land Use	**TP**	**TN**
Waste Appl. Fields	5.46	12.3
Forage Fields	1.04	5.4
Wood/Range	0.20	0.6
Urban	2.23	10.0

[1] Adapted from McFarland and Hauck (2001).

- **Clesceri, N. L., Curran, S. J., and Sedlak, R. I. (1986). Nutrient Loads to Wisconsin Lakes: Part I, Nitrogen and Phosphorus Export Coefficients.** This publication contains TN and TP, as well as orthophosphate and inorganic nitrogen export coefficients calculated for three land uses (forest, mixed, and agriculture) at 17 watersheds located throughout Wisconsin. Export coefficients are given for each individual watershed, as well as the mean value from all sites (Table 5).

Table 5
TP and TN Mean Export Coefficients by Land Use for Wisconsin[1]

	TP and TN Coefficients (kg/ha/yr)			
	TP		TN	
Land Use	**Mean**	**SD**	**Mean**	**SD**
Forest	.112	.023	3.72	0.30
Mixed	.176	.032	4.07	1.01
Agricultural	.262	.122	6.69	4.82

[1] Adapted from Clesceri et al. (1986).

- **Dodd, R. C., McMahon, G. and Stichter, S. (1992). Watershed Planning in the Albemarle-Pamlico Estuarine System.** This report contains median export coefficients (Table 6) based on a literature review of at least 78 studies (not documented in the report), which were then used to estimate nutrient loading in watersheds in the Albermarle-Pamlico estuarine system, located on the North Carolina-Virginia coastal areas.

Table 6
Median and 25%-75% Range of TP and TN Export Coefficients Used in Albemarle-Pamlico Estuarine System Study[1]

	Export Coefficient (kg/ha/yr)					
	TP			TN		
Land Use	**Low (25%)**	**Median**	**High (75%)**	**Low (25%)**	**Median**	**High (75%)**
Agriculture	0.55	0.99	2.03	5	9.8	14.3
Forest/wetland	0.09	0.13	0.21	0.69	2.33	3.8
Developed	0.45	1.06	1.5	5	7.5	9.72

[1] Adapted from Dodd et al. (1992).

Event Mean Concentrations (EMCs): Event mean concentrations are generally used for calculating runoff pollutant loads for urban land use types. In order to calculate total pollutant load into a system using EMCs, surface imperviousness of individual land uses and precipitation data for the area are required.

- **Smullen et al. (1999). Updating the U.S. Nationwide Urban Runoff Quality Database, and U.S. EPA (1983). Results of the Nationwide Urban Runoff Program.** In 1983, the U.S. Environmental Protection Agency published the results of the Nationwide Urban Runoff Program (NURP), which nationally characterizes urban runoff for 10 water quality pollutants, based on data from 81 urban sites in 28 metropolitan areas. Subsequently, the USGS created another urban stormwater runoff base (Driver et al. 1985), based on data measured at 97 urban sites located in 21 metropolitan areas. The authors combined and analyzed data from both of these major studies, along with additional data collected by individual cities as part of

stormwater discharge permit applications. Pooled mean and median EMCs from the combined data sets are provided and compared to the NURP data (Table 7). One limitation to the numbers in Table 7 is that they do not distinguish between different urban land use types. However, one conclusion of the NURP study was that due to the amount of site-to-site variability, any differences in EMCs between different urban land uses (residential, commercial, and mixed) or geographic regions were for the most part not significant.

Table 7
Nationally Pooled Urban EMCs Compared to NURP EMCs[1]

Constituent	Units	Data Source	EMCs	
			Mean	Median
TSS	mg/l	Pooled	78.4	54.5
		NURP	174	113
BOD	mg/l	Pooled	14.1	11.5
		NURP	10.4	8.39
COD	mg/l	Pooled	52.8	44.7
		NURP	66.1	55
TP	mg/l	Pooled	0.315	0.259
		NURP	0.337	0.266
Soluble P	mg/l	Pooled	0.129	0.103
		NURP	0.1	0.078
TKN	mg/l	Pooled	1.73	1.47
		NURP	1.67	1.41
NO_2 and NO_3	mg/l	Pooled	0.658	0.533
		NURP	0.837	0.666
Cu	µg/l	Pooled	13.5	11.1
		NURP	66.6	54.8
Pb	µg/l	Pooled	67.5	50.7
		NURP	175	131
Zn	µg/l	Pooled	162	129
		NURP	176	140

1 Adapted from Smullen et al. (1999).

- **Line, D. E. et al. (2002). Pollutant Export from Various Land Uses in the Upper Neuse River Basin.** This publication contains several EMCs for various land uses (Table 8), obtained from monitoring six small drainage areas within the Upper Neuse River Basin, located in east-central North Carolina.

Table 8
Mean and Median EMCs for Various Land Uses in the Upper Neuse River Basin, NC[1]

Land Use	Event Mean Concentration (mg/l)									
	NO_3-N		TKN		NH_3-N		TP		TSS	
	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean
Residential	0.49	0.79	1.48	5.92	0.34	0.55	0.40	0.59	42	73
Golf Course	1.01	1.02	5.12	6.85	0.35	0.79	0.82	1.07	150	202
Industrial	0.31	0.46	0.99	1.39	0.14	0.25	0.23	0.27	170	231
Pasture	0.43	1.30	3.18	3.46	0.18	0.31	1.56	2.14	84	151
Construction-I[2]	0.25	0.21	1.10	1.08	0.08	0.09	0.21	0.43	2,143	3,491
Construction-II[3]	0.50	1.00	1.87	5.69	0.29	0.86	0.21	0.28	985	1,453
Wooded	0.10	1.00	1.37	3.58	0.08	0.09	0.25	0.35	113	487

[1] Adapted from Line et al. (2002).
[2] Construction I - clearing, grubbing, and grading of former wooded/agricultural land.
[3] Construction II – installation of roads, storm drainage, and housing.

- **Baldys, S. et al. (1998). Urban Stormwater Quality, Event-Mean Concentrations, and Estimates of Stormwater Pollutant Loads, Dallas-Fort Worth Area, Texas, 1992-1993.** This report contains EMCs based on data collected at 26 sites in the Dallas-Fort Worth Area, TX (Table 9).

Table 9
Mean and Median EMCs of Select Constituents for Various Urban Land Uses in the Dallas-Ft. Worth Area, Texas[1]

Land Use	Event Mean Concentration (mg/l)							
	TN		TKN		TP		TSS	
	Median	Mean	Median	Mean	Median	Mean	Median	Mean
Residential	1.7	2.1	1.1	1.5	0.33	0.38	78	127
Commercial	1.2	1.5	0.80	0.96	0.14	0.18	52	60
Industrial	1.4	1.5	0.80	0.86	0.21	0.28	104	222

[1] Adapted from Baldys et al. (1998).

- **Guerard, P., and Weiss, W. B. (1995). Water Quality of Storm Runoff and Comparison of Procedures for Estimating Storm-Runoff Loads, Volume, Event-Mean Concentrations, and the Mean Load for a Storm for Selected Properties and Constituents for Colorado Springs, Southeastern Colorado, 1992.** This paper contains mean and median EMCs of several pollutants at five sites located in the city of Colorado Springs, Colorado (Table 10). Rather than assign a land use to each site, the percent coverage of each land use in the sites catchment is given, although for the most part each catchment had one dominant (>50 percent) land use.

Table 10
Mean and Median EMCs of Select Constituents for Various Urban Catchment Land Uses in Colorado Springs, CO

Predominant Land Use	Event Mean Concentration (mg/l)									
	NO_3+NO_2		TKN		NH_3-N		TP		TSS	
	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean
Commercial[2]	0.80	0.73	1.70	1.80	0.67	0.60	0.29	0.28	274	284
Industrial and undeveloped[3]	0.87	0.80	1.10	1.40	0.43	0.49	0.17	0.24	464	595
Industrial[4]	1.00	0.95	2.90	2.90	0.99	1.01	0.33	0.36	220	220
Residential[5]	0.47	0.59	3.80	3.80	0.39	0.49	0.72	0.75	100	229
Undeveloped and commercial[6]	1.20	1.20	2.30	3.30	1.00	1.30	0.59	0.60	826	846

[1] Adapted from Guerard and Weiss (1995).
[2] Actual catchment land use: 61.1% commercial, 23.0% undeveloped, 15.9% residential.
[3] Actual catchment land use: 54.7% industrial, 35.9% undeveloped, 8.5% residential, 0.9% commercial.
[4] Actual catchment land use: 79.5% industrial, 17.8% commercial, 2.7% residential.
[5] Actual catchment land use: 79.4% residential, 9.3% commercial, 8.3% public, 3.0% undeveloped.
[6] Actual catchment land use: 43.0% undeveloped, 39.9% commerical, 10.3% industrial, 6.8% residential.

- **Los Angeles County Stormwater Monitoring Report: 1998-1999 (1999).** Many large cities and counties conduct their own stormwater monitoring, and thus are sources for obtaining locally generated EMC values. One example is the Los Angeles County Department of Public Works, which publishes annual stormwater monitoring reports on its Website. The following link: http://ladpw.org/wmd/NPDES/9899TC.cfm is for the 1998-1999 report, which contains EMCs measured from several years for specific urban land use types in the county. Some of these data are summarized in Table 11.

Table 11
EMCs of Select Constituents Measured During the 1997-98 Storm Season for Various Urban Land Uses in Los Angeles County, CA[1]

Land Use	Event Mean Concentration (mg/l)				
	NO_3+NO_2	TKN	NH_3	TP	TSS
High-density residential	0.38	2.27	0.29	0.28	81.54
Light industrial	0.48	3.09	0.38	0.50	404.39
Vacant	0.91	0.72	0.11	0.13	96.86
Retail/commercial	0.65	1.67	0.30	0.40	48.80
Multi-family residential	0.27	1.50	0.39	0.13	30.90
Mixed residential	0.44	2.23	0.46	0.25	65.18

[1] Adapted from Los Angeles County Stormwater Monitoring Report: 1998-1999).

- **Harper, H. H. (1998) Stormwater Chemistry and Water Quality.** This publication is available on the Web at: http://www.stormwater-resources.com/Library/045PlChemistry.pdf. It contains summary EMCs by land use from 40 reports/studies from the state of Florida (Table 12).

Table 12
EMCs of Select Constituents Measured for Various Land Uses in Central and South Florida)[1]

Land Use	Event Mean Concentration (mg/l)			
	TN	TP	TSS	BOD
Low-density residential	1.77	0.18	19.10	4.40
Single family residential	2.29	0.30	27.00	7.40
Multi-family residential	2.42	0.49	71.70	11.00
Low-intensity commericial	1.18	0.15	81.00	8.20
High-intensity commercial	2.83	0.43	94.30	7.20
Industrial	1.79	0.31	93.90	9.60
Highway	2.08	0.34	50.30	5.60
Pasture	2.48	0.476	94.3	5.1
Citrus	2.05	0.14	16.3	2.55
Row crops	2.68	0.562		
General agriculture	2.32	0.344	55.3	3.8
Open space	1.25	0.053	11.1	1.45
Mining	1.18	0.15	93.94	9.64
Wetland	1.6	0.19	10.2	4.63
Open water/lake	1.25	0.11	3.1	1.6

[1] Adapted from Harper, H. H. (1998).

- **Brezonik, P. L., and Stadelmann, T. H. (2001). Analysis and Predictive Models of Stormwater Runoff Volumes, Loads, and Pollutant Concentrations from Watersheds in the Twin Cities Metropolitan Area, Minnesota, USA.** This publication provides ranges of EMCs for various watershed land uses in the Twin Cities area, MN (Table 13). Median EMCs by land use are depicted in box-plot form; therefore, it is not possible to interpolate exact numbers for that statistic from the paper. However, mean and median EMC statistics are provided for the combined watershed data set that was used (Table 14).

Table 13
Range of EMCs Measured for Select Constituents, Grouped by Various Watershed Land Uses in the Twin Cities Metro Area, MN[1]

Land Use	Event Mean Concentration Ranges (mg/l)				
	TN	TKN	NO_3-N	TP	TSS
Urban residential ≤ 40ha	0.44-8.79	1.20-5.40	0.01-1.20	0.05-1.84	16-636
Urban residential > 40ha	0.52-19.4	1.12-6.99	0..07-1.90	0.03-3.81	3-1570
Suburban residential ≤ 40ha	0.82-14.7	0.61-13.5	0.08-2.10	0.11-9.40	7-3577
Subrban residential > 40ha	0.60-19.1	0.42-18.5	0.05-2.10	0.08-3.40	6-2400
Commercial/industrial	1.80-8.18	1.38-7.39	0.18-0.86	0.22-0.77	42-418
Mixed use	0.43-18.6	0.21-18.0	0.15-2.05	0.04-1.8	12-3240

[1] Adapted from Brezonik and Stadelmann (2001).

Table 14
Mean and Median EMCs Measured for Select Constituents in the Twin Cities Metro Area, MN[1]

TN		TKN		NO_3-N		TP		TSS	
Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean
2.50	3.08	1.85	2.62	0.44	0.53	0.41	0.58	88	184

[1] Adapted from Brezonik and Stadelmann (2001).

REGIONAL TRENDS: There is some question as to the applicability of applying export coefficients or event mean concentrations for different land uses developed in one part of the country to another region. As seen in the tables and reports presented above, wide variation can exist not only regionally, but on a local scale as well. Furthermore, national mean concentrations or coefficients obtained by averaging numbers from a variety of geographically disbursed studies can still yield differing results. For example, Rast and Lee (1983, Table 2) suggest using a national TP export coefficient of 0.5 kg/ha/yr for agricultural land use, and 0.05-0.1 kg/ha/yr for forested land use. However, mean values for TP coefficients as reported in Reckhow et al. (1980) are much higher- 0.236 kg/ha/yr for forested land use and 1.08-4.46 kg/ha/yr for agricultural land use (row and non-row crops).

Omernik (1976, 1977) conducted an extensive study looking at relationships between regionality (as well as a variety of other factors) and nutrient export and concentrations in streams. The 1976 report examined regional relationships of TN and TP concentrations among four general regions within the Eastern United States. Although differences exist in concentrations among the regions, Omernik cautions that use of these distinctions is limited due largely to small sample sizes.

The 1977 report includes several maps depicting ranges of nitrogen and phosphorus concentrations across the entire United States. Two of these maps (for total phosphorus and total nitrogen) are reproduced in this technical note (Figures 1 and 2). A few noticeable trends are evident in these maps. Total phosphorus concentrations are generally higher in the West than they are in the East. Also, total nitrogen concentrations are higher in the eastern region than in the central or western regions. Some of these differences are attributable to differing regional land use (for instance, areas in the far northeast and northwest corners of the country have relatively low TP and TN concentrations, due to those areas containing watersheds that are largely forested). Conversely, TP and TN concentrations are relatively high in large portions of the Midwest containing primarily agricultural watersheds. What is not as obvious from Figures 1 and 2 is whether or not TP or TN concentrations are generally any higher for an agricultural area in the Midwest than for any other agricultural area of the country. However, further analysis by Omernik (1977) does suggest some regional trends correlating to land use (Table 15). For instance, for a given land use, there appears to be a west-to-east decrease in phosphorus concentrations in streams across the United States. This trend is the most apparent for forested land-use watersheds (>75 percent forest), where phosphorus concentrations are approximately twice as high in the West as in the East. Conversely, TN concentrations in streams tend to be higher in the eastern region than the central or western regions. The differences are small in forest watersheds, but fairly pronounced in agricultural watersheds. In watersheds with more than 90 percent agricultural land use, TN concentrations are approximately

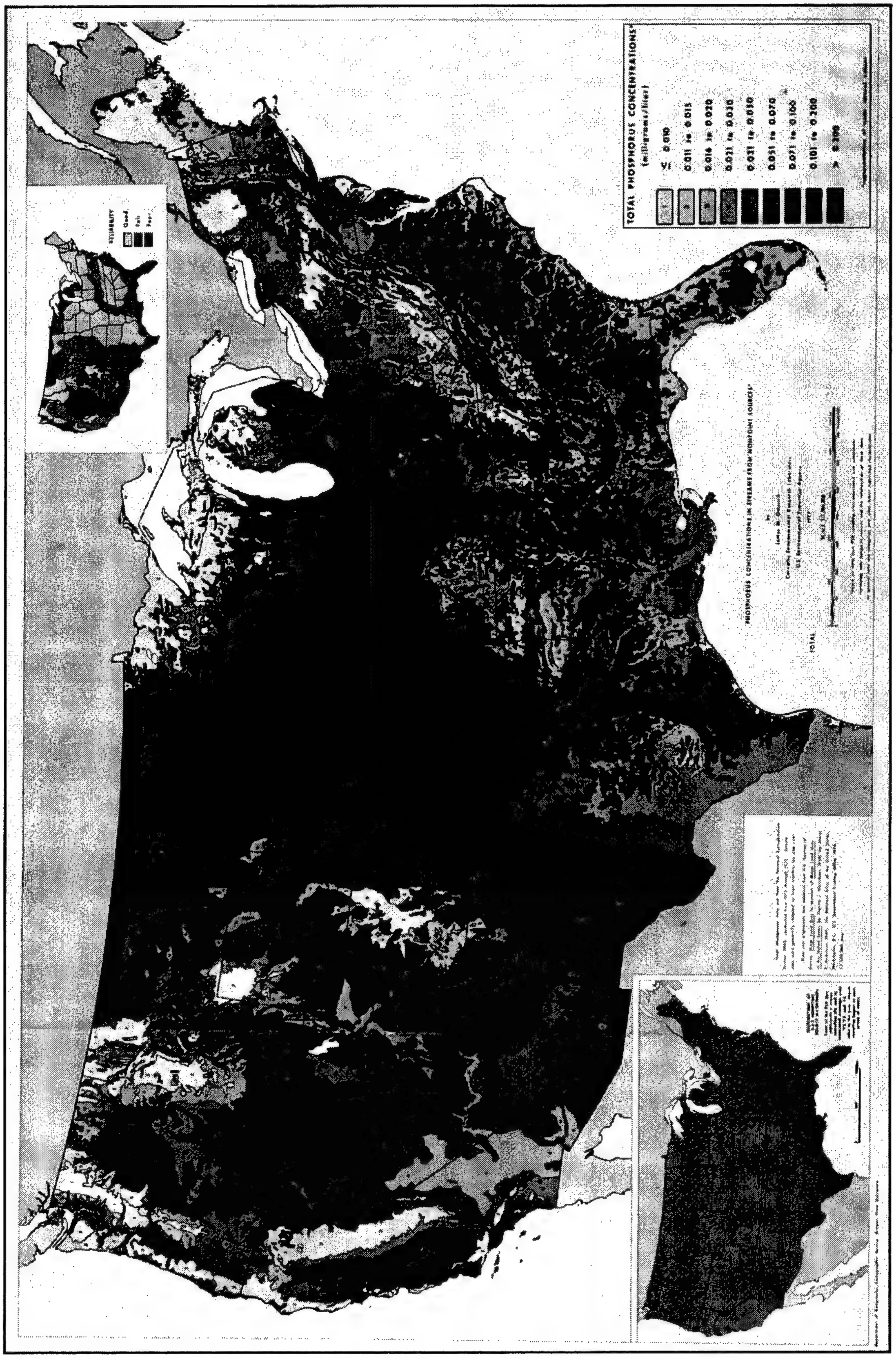

Figure 1. Total phosphorus concentrations in streams from non-point sources across the United States (reprinted from Omernick 1977)

Figure 2. Total nitrogen concentrations in streams from non-point sources across the United States (reprinted from Omernick 1977)

3.5 times higher in the East than in the West. The numbers from this report suggest that, for certain land uses, it may not be accurate to apply a coefficient/concentration obtained in one region of the country to another.

Table 15
Comparison of TP and TN Concentrations by Watershed Land Use in Western, Central, and Eastern Regions of the United States[1]

Watershed Land Use	Mean Concentrations in Streams (mg/l)					
	TP by Region			TN by Region		
	West	Central	East	West	Central	East
≥ 90% Forest	0.022	0.020	0.011	0.601	0.501	0.658
≥ 75% Forest	0.029	0.025	0.015	0.601	0.622	0.719
≥ 50% Forest	0.028	0.036	0.036	0.694	0.778	0.907
≥ 50% Agriculture	0.123	0.117	0.070	1.615	1.741	1.858
≥ 75% Agriculture	0.173	0.140	0.134	2.833	1.931	3.005
≥ 90% Agriculture	0.154	0.214	0.152	1.735	2.366	6.082

[1] Adapted from Omernik (1977).

Two caveats should be made concerning the regional/land use correlations shown in Table 15. First, any regional correlation should be qualified with the fact that the sample size of watersheds used in the western region of the country was relatively small. Also, since these data were published more than 25 years ago, it is possible that current agricultural or forestry practices, as well as changing land uses nationwide, have altered or erased any correlations that may have been evident at the time the report was published. Nevertheless, the maps and data presented in the two Omernik reports do suggest there is some validity to using regionalized coefficients.

Ultimately, the suitability of applying regional coefficients may depend largely on the goals of the particular study. If the study is conducted primarily for local comparative purposes (comparing/ranking nutrient loads into local watersheds or catchments), then using regional or national values may suffice. However, if accurate pollutant estimates are required, researchers should look into obtaining (or generating their own) local coefficients/concentrations for their area of interest. The tables and references provided in this report can be used as a source or starting point for these efforts.

POINTS OF CONTACT: This technical note was written by Mr. Jeff P. Lin, at the U.S. Army Engineer Research and Development Center, Vicksburg, MS. For additional information, contact Mr. Lin (601-634-2068, Jeff.P.Lin@erdc.usace.army.mil) or the Manager of the Wetlands Regulatory Assistance Program, Mr. Robert Lazor (601-634-2935, Bob.L.Lazor@erdc.usace.army.mil). This technical note should be cited as follows:

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